

What is claimed is:

1 1. A method for allocating user transmission rates in a communication system that is
2 adapted to permit the users to transmit data simultaneously via shared frequency and
3 spatial resources, the method comprising:

4 while maintaining the transmission rates of the users to at least a minimum user
5 transmission rate to provide an expected minimum quality of communication for each of
6 the users, incrementally adjusting the transmission rates of the users by iteratively
7 changing the transmission rate of each user as a function of

8 a resulting vector of transmit powers ensuing from the increased
9 transmission rate,

10 a degree of transmission-rate-allocation unfairness relative to the
11 transmission rates of all the users, and

12 a power-based selection criteria.

1 2. The method of claim 1, wherein the degree of transmission-rate-allocation
2 unfairness is a function of a ratio of a maximum user transmission rate to a minimum user
3 transmission rate.

1 3. The method of claim 1, further including using the resulting vector and the degree
2 of transmission-rate-allocation unfairness to identify a user for the corresponding
3 iteration and, therefrom, increasing its transmission rates in a next iteration.

1 4. The method of claim 1, further including using the resulting vector and the degree
2 of transmission-rate-allocation unfairness to identify a user from the set of all users, that
3 optimizes the selection criteria for the corresponding iteration and, therefrom, increasing
4 its transmission rates in a next iteration.

1 5. The method of claim 1, wherein the system is an OFDM (orthogonal-frequency-
2 division-multiplex) communication system and further including transmitting the data
3 from the users using OFDM communication.

1 6. The method of claim 1, wherein the system is a CDMA (code-division-multiple-
2 access) communication system and further including transmitting the data from the users
3 using CDMA communication.

1 7. The method of claim 1, further including setting the transmission rates of the
2 users to the minimum user transmission rate before incrementally adjusting the
3 transmission rates of the users.

1 8. The method of claim 1, wherein iteratively changing the transmission rate of each
2 user includes iteratively changing the transmission rate by a constant.

1 9. The method of claim 1, wherein the power-based selection criteria is selected
2 from the set of: minimization of average transmit power; minimization of maximum
3 transmit power; and minimization of total received power.

1 10. A method for allocating transmission rates to multiple users in a communication
2 system that is adapted to permit the users to transmit data simultaneously via shared
3 frequency and spatial resources, the method comprising:

4 (a) setting the transmission rates of the users to at least a minimum user
5 transmission rate to provide an expected minimum quality of communication for each of
6 the users and then incrementally adjusting the transmission rates of the multiple users by
7 iteratively increasing the transmission rates per the following steps:

8 (b) for each user, increasing its transmission rate without changing the
9 transmission rate of the other users, thereby providing a set of transmission rates that
10 include a maximum user transmission rate and a minimum user transmission rate and,
11 therefrom, determining

12 a resulting vector of transmit powers ensuing from the increased
13 transmission rate, and

14 a degree of transmission-rate-allocation unfairness as a function of a ratio
15 of a maximum user transmission rate to a minimum user transmission rate;

16 (c) from the resulting vector and the degree of transmission-rate-allocation
17 unfairness, determining whether an increased one of the transmission rates for a
18 corresponding one of the users satisfies a multi-user based selection criteria and, in
19 response, increasing its transmission rate.

1 11. The method of claim 10, wherein the multi-user based selection criteria includes a
2 power-based selection criteria, and further including, after step (c), repeating steps (b)

3 and (c) until an iteration in which none of the transmission rates satisfies the power-based
4 selection criteria and satisfies the degree of transmission-rate-allocation unfairness.

1 12. The method of claim 10, wherein the system is an OFDM (orthogonal-frequency-
2 division-multiplex) communication system and further including transmitting the data
3 from the users using OFDM communication.

1 13. The method of claim 12, wherein the multi-user based selection criteria includes a
2 power-based selection criteria, and further including, after step (c), repeating steps (b)
3 and (c) until an iteration in which none of the transmission rates satisfies the power-based
4 selection criteria and satisfies the degree of transmission-rate-allocation unfairness.

1 14. The method of claim 10, wherein the system is an OFDM (orthogonal-frequency-
2 division-multiplex) communication system permitting the users to transmit the data on
3 multiple frequencies and further including transmitting the data from the users using
4 OFDM communication.

1 15. The method of claim 10, wherein the system is a CDMA (code-division-multiple-
2 access) communication system and further including transmitting the data from the users
3 using CDMA communication.

1 16. The method of claim 15, wherein the multi-user based selection criteria includes a
2 power-based selection criteria, and further including, after step (c), repeating steps (b)

3 and (c) until an iteration in which none of the transmission rates satisfies the power-based
4 selection criteria and satisfies the degree of transmission-rate-allocation unfairness.

1 17. The method of claim 10, further including, after step (c), repeating steps (b) and
2 (c) until an iteration in which none of the transmission rates satisfies the degree of
3 transmission-rate-allocation unfairness.

1 18. The method of claim 10, further including, after step (c), repeating steps (b) and
2 (c) until an iteration in which none of the transmission rates satisfies the multi-user based
3 selection criteria.

1 19. The method of claim 10, further including, after step (c), repeating steps (b) and
2 (c) until an iteration in which none of the transmission rates satisfies the multi-user based
3 selection criteria and, thereafter, attempting to optimize system operation.

1 20. A communication system adapted to allocate transmission rates to multiple users
2 and to permit the users to transmit data simultaneously via shared frequency and spatial
3 resources, the system comprising:

4 means for maintaining the transmission rates of the users to at least a minimum
5 user transmission rate to provide an expected minimum quality of communication for
6 each of the users; and

7 means, operative while maintaining the transmission rates of the users to at least a
8 minimum user transmission rate, for incrementally adjusting the transmission rates of the
9 users by iteratively changing the transmission rate of each user as a function of
10 a resulting vector of transmit powers ensuing from the increased
11 transmission rate,
12 a degree of transmission-rate-allocation unfairness relative to the
13 transmission rates of all the users, and
14 a power-based selection criteria.

1 21. A communication system adapted to allocate transmission rates to multiple users
2 and to permit the users to transmit data simultaneously via shared frequency and spatial
3 resources, the system comprising:

4 means for setting the transmission rates of the users to at least a minimum user
5 transmission rate to provide an expected minimum quality of communication for each of
6 the users; and

7 means for incrementally adjusting the transmission rates of the multiple users by
8 iteratively increasing the transmission rates as follows:

9 for each user, increasing its transmission rate without changing the
10 transmission rate of the other users, thereby providing a set of transmission rates that
11 include a maximum user transmission rate and a minimum user transmission rate and,
12 therefrom, determining

13 a resulting vector of transmit powers ensuing from the increased
14 transmission rate, and

15 a degree of transmission-rate-allocation unfairness as a function of a ratio
16 of a maximum user transmission rate to a minimum user transmission rate; and
17 from the resulting vector and the degree of transmission-rate-allocation
18 unfairness, determining whether an increased one of the transmission rates for a
19 corresponding one of the users satisfies a multi-user based selection criteria and, in
20 response, increasing its transmission rate.

1 22. The system of claim 21, wherein the system is an OFDM (orthogonal-frequency-
2 division-multiplex) communication system permitting the users to transmit the data on
3 multiple frequencies and further including transmitting the data from the users using
4 OFDM communication.

1 23. The method of claim 21, wherein the system is a CDMA (code-division-multiple-
2 access) communication system and further including transmitting the data from the users
3 using CDMA communication.

1 24. The method of claim 21, wherein the system is a CDMA (code-division-multiple-
2 access) cellular communication system and wherein the rate allocation is provided to
3 multiple users communicating with a common base station for the cellular
4 communication system, and further including transmitting the data from the users to
5 common base station using CDMA communication.

- 1 25. For use in a communication system adapted to allocate transmission rates to
2 multiple users and to permit the users to transmit data simultaneously via shared
3 frequency and spatial resources, a data terminal comprising:
4 a clock-based circuit that maintains a data transmission rate of the data terminal as
5 a function of a minimum user transmission rate defined to provide an expected minimum
6 quality of communication for each of the users; and
7 a data transmission rate adjustment circuit that incrementally adjusts the
8 transmission rate of the data terminal as a function of
9 a resulting vector of system-level transmit powers ensuing from the
10 incremental adjustment of the transmission rate,
11 a degree of transmission-rate-allocation unfairness relative to the
12 transmission rates of all the users, and
13 a system-level power-based selection criteria.